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EFFECT OF COAL INVENTORIES ON STABILITY OF THE COAL INDUSTRY

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EFFECT OF COAL INVENTORIES ON STABILITY OF THE COAL INDUSTRY

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ABSTRACT

This analysis of changes in past coal consumption and inventories was undertaken to determine the extent to which inventories contribute to the general stability or instability of the coal industry.

Coal inventories are of two types: 1) seasonal inventories built up during the summer for use during the winter, and 2) protective inventories, held to assure adequate supplies of coal in the event of an interruption in supply. Seasonal inventories tend to stabilize production by leveling out the troughs and peaks of seasonal consumption. Protective inventories tend to follow changes in the rate of consumption and thus to accentuate their effects. As a result, fluctuations in coal production far exceed those that might be expected on the basis of changes in the amount of coal used by consuming industries.

Studies of seasonally adjusted consumptions and inventories reveal a distinct pattern of behavior when significant changes in industrial activity occur. Such studies may be useful in forecasting changes in the demand for coal, and the information may be valuable to both producers and consumers in planning their operations and inventory policies.

INTRODUCTION

This analysis of changes in past coal consumption and coal inventory practices was undertaken in order to determine the extent to which inventories contribute to the general stability or instability of the coal industry. The stabilizing effect upon the coal industry of seasonal inventories is widely recognized, but somewhat less apparent is the unstabilizing effect of protective inventories which tend to emphasize the influence of changes in the level of industrial activity. It was hoped that such an analysis might be valuable to both the coal industry and to consumers in planning their operations and inventory policies. The paper was first presented before the Mid-America Minerals Conference of the American Institute of Mining, Metallurgical and Petroleum Engineers in St. Louis, Missouri, October 23, 1958.

TYPES OF COAL INVENTORIES

On September 30, 1958, the major coal-consuming groups of the United States held a total of 74 million tons of coal in inventory stocks. This was equal to more than 15 percent of the average quantity produced annually during the 10-year period, 1948 through 1957. It represented a 75-day supply of coal at the rate of consumption then current.

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The size of coal inventories in the United States tends to vary widely, both seasonally and on a year-to-year basis. The extent of such variations is shown in tables 1 and 2.

Table 1. - Coal Inventories in Hands of Commercial Consumers and Retail Dealers' Yards, by Months, During 1957

| Date | Tons (millions) | | Tons (millions) |
|------------|--------------------|-------------|--------------------|
| January 1 | 78.0 | July 1 | 78.3 |
| February 1 | 73.0 | August 1 | 75.0 |
| March 1 | 71.3 | September 1 | 77.7 |
| April 1 | 72.0 | October 1 | 79.8 |
| May 1 | 73.3 | November 1 | 81.4 |
| June 1 | 76.1 | December 1 | 81.3 |

Source: U. S. Bureau of Mines.

Table 2. - Coal Inventories in Hands of Commercial Consumers and Retail Dealers' Yards, 1948-1958
(As of January 1)

| Year | Tons (millions) | Year | Tons (millions) |
|------|--------------------|------|--------------------|
| 1948 | 52.2 | 1954 | 80.6 |
| 1949 | 69.4 | 1955 | 69.2 |
| 1950 | 45.1 | 1956 | 68.4 |
| 1951 | 72.5 | 1957 | 78.0 |
| 1952 | 76.6 | 1958 | 80.8 |
| 1953 | 76.7 | | |

Source: U. S. Bureau of Mines.

Inventories may roughly be classified by type according to their purpose. The first type is the seasonal inventory, built up during the "off season" when consumption is low, for use during the period when the requirement for coal increases. This type of inventory has special significance in cases in which the coal is used to provide heat or warmth, as in domestic heating and other similar uses.

The second type of inventory, which might be called a protective inventory, is built up primarily as a protection against possible interruptions in coal supplies. The level of such inventories usually is based on current operating conditions and the rate of coal consumption. For example, a given concern may maintain a 30-, 60-, or 90-day supply at its current rate of consumption, in accordance with its inventory policy.

The function that the coal serves determines to a large extent whether the consumer maintains seasonal inventories, protective inventories, or a combination of both. Tables 3 and 4 show the inventories of coal held at specified times by several major consumer groups - electric power utilities, coke plants, other industries, and retail. These groups consume about 93 percent of the coal used in the United States each year and normally they hold about 96 percent of the country's total coal inventories.

Table 3. - Coal Inventories in Hands of Major Consumer Groups,
By Months, During 1957
(In millions of tons)

| Date | Electric power utilities | Coke plants | Other industrials | Retail |
|-------------|-----------------------------|----------------|----------------------|--------|
| January 1 | 46.0 | 13.9 | 14.1 | 1.1 |
| February 1 | 43.4 | 12.8 | 13.2 | 0.8 |
| March 1 | 42.3 | 12.8 | 12.9 | 0.8 |
| April 1 | 42.8 | 13.3 | 12.8 | 0.6 |
| May 1 | 44.0 | 13.3 | 13.0 | 0.7 |
| June 1 | 45.9 | 13.9 | 13.0 | 0.8 |
| July 1 | 47.6 | 14.0 | 13.1 | 0.9 |
| August 1 | 47.5 | 11.7 | 12.4 | 0.9 |
| September 1 | 49.1 | 12.5 | 12.5 | 1.0 |
| October 1 | 50.5 | 13.0 | 12.7 | 1.0 |
| November 1 | 51.2 | 13.9 | 12.6 | 0.9 |
| December 1 | 51.1 | 14.0 | 12.6 | 1.0 |

Days supply, at current rate of consumption

| | | | | |
|-------------|-----|----|----|----|
| January 1 | 99 | 46 | 52 | 9 |
| February 1 | 86 | 42 | 45 | 4 |
| March 1 | 91 | 42 | 45 | 5 |
| April 1 | 98 | 44 | 49 | 6 |
| May 1 | 108 | 45 | 52 | 7 |
| June 1 | 115 | 47 | 58 | 14 |
| July 1 | 117 | 48 | 62 | 18 |
| August 1 | 118 | 40 | 62 | 19 |
| September 1 | 117 | 43 | 59 | 14 |
| October 1 | 121 | 45 | 58 | 12 |
| November 1 | 117 | 50 | 50 | 8 |
| December 1 | 114 | 53 | 48 | 9 |

Source: U. S. Bureau of Mines.

Retail sellers' inventories are principally seasonal - that is, the retailers build up their inventories during the summer months to assure an adequate supply during cold winter months when the demand for fuel is high. Also, they can buy coal at lower prices during the summer months. Table 3 shows a decline of more than 40 percent in the size of retail coal stocks from midwinter to early spring.

The plants classified as "other industrials" also build up some seasonal inventories, but significantly larger percentages are in their protective inventories. In contrast, inventories by coke plants (and also by cement plants, steel plants, and railroads, not shown in tables 3 and 4) have little or no seasonal significance, except perhaps where coal may be bought in summer to take advantage of lower prices.

Electric utilities use a combination of both types of inventories. During the summer months while large quantities of natural gas are consumed by the electric utilities, inventories of coal are being accumulated for use during the winter when gas is reserved for domestic purposes. In addition to these seasonal

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Table 4. - Coal Inventories in Hands of Major Consumer Groups, 1948-1958
(As of January 1)

| Year | Electric power utilities | Coke plants | Other industrials | Retail |
|------|-----------------------------|----------------|----------------------|--------|
| 1948 | 16.8 | 9.1 | 15.3 | 2.0 |
| 1949 | 24.8 | 12.1 | 18.0 | 2.7 |
| 1950 | 17.8 | 9.9 | 10.2 | 1.4 |
| 1951 | 27.1 | 16.8 | 18.7 | 2.5 |
| 1952 | 33.4 | 15.3 | 19.4 | 1.8 |
| 1953 | 35.9 | 14.4 | 19.1 | 1.7 |
| 1954 | 39.8 | 16.5 | 17.8 | 1.5 |
| 1955 | 39.7 | 12.3 | 13.0 | 0.8 |
| 1956 | 38.2 | 13.3 | 12.9 | 1.0 |
| 1957 | 46.0 | 13.9 | 14.1 | 1.1 |
| 1958 | 50.3 | 14.1 | 12.7 | 0.9 |

Days supply, at current rate of consumption

| | | | | |
|------|-----|----|----|----|
| 1948 | 62 | 34 | 52 | 33 |
| 1949 | 90 | 43 | 53 | 46 |
| 1950 | 77 | 39 | 35 | 32 |
| 1951 | 93 | 61 | 58 | 50 |
| 1952 | 112 | 55 | 62 | 56 |
| 1953 | 107 | 50 | 62 | 58 |
| 1954 | 117 | 62 | 60 | 64 |
| 1955 | 106 | 48 | 56 | 60 |
| 1956 | 82 | 44 | 39 | 47 |
| 1957 | 99 | 46 | 52 | 62 |

Source: U. S. Bureau of Mines.

inventories, a 2- to 3-month supply of coal is also kept as protection against possible interruptions in supply. The utilities' gradual increase in coal consumption is reflected in the steady growth of their inventories over recent years.

PATTERNS OF COAL CONSUMPTION

Recent changes in the patterns of coal consumption have materially changed the relative significance of the two types of inventories. Figure 1 shows the consumption of coal by the major consumer groups during the past 25 years. It shows that retail consumption, in which seasonal inventories are an important factor, has declined in relative importance. Likewise the growth of electric power, which has both seasonal and protective inventories, and of coke, which has primarily protective inventories, is apparent.

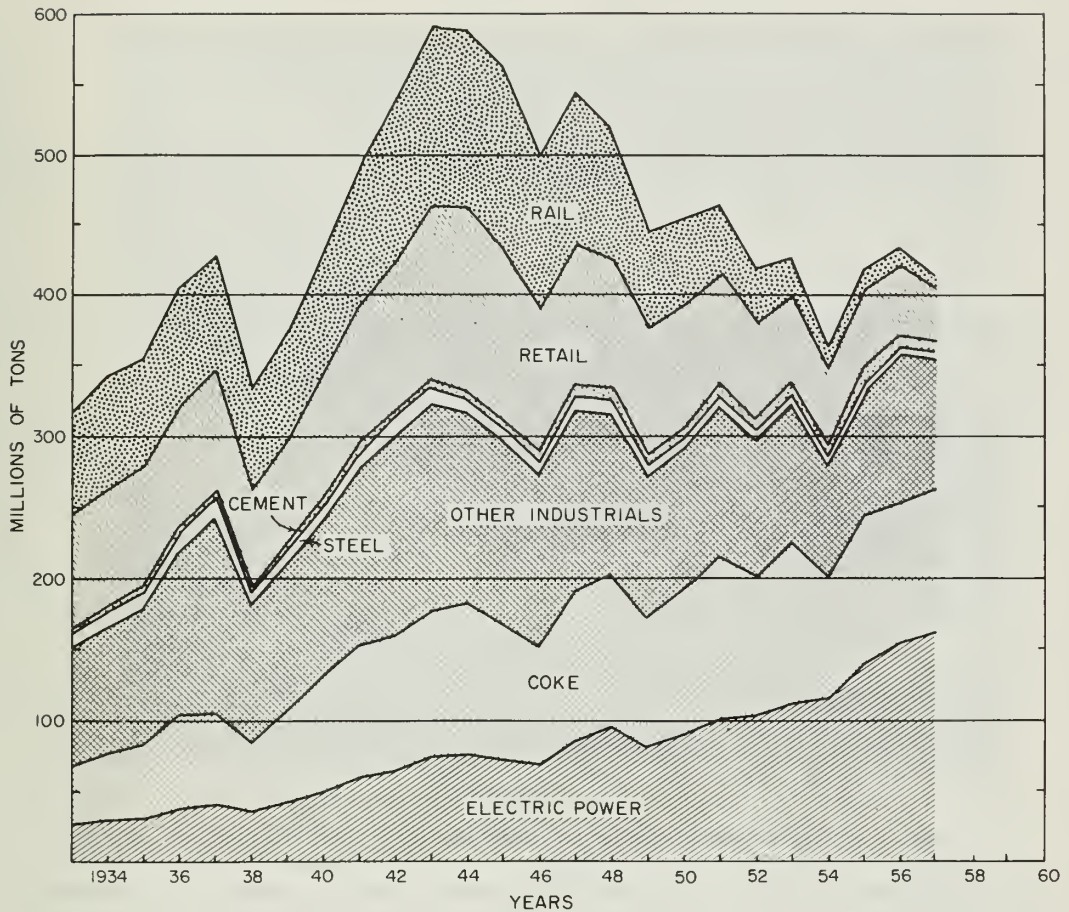


Fig. 1. - United States consumption of coal, by consumer groups.

Figure 2 illustrates, perhaps even more graphically, changes in the relative importance of the consumer groups. Railroad and retail use, which in 1933 accounted for almost 50 percent of total consumption, now account for about 10 percent. Electric power, coke, and other industrials, which accounted for less than 50 percent in 1933, now consume about 85 percent of the coal; they also are the major holders of protective inventories.

EFFECT OF FLUCTUATIONS

The use of coal inventories by consumer groups can have either a beneficial or detrimental effect on coal industry stability, depending upon the type of inventory involved.

Seasonal inventories have a stabilizing effect upon the coal industry. The accumulation of such inventories during summer months for consumption during winter months tends to level out the peaks and troughs in production that otherwise would occur. Thus the total annual need for coal can be supplied with a lower productive capacity than otherwise would be required. Seasonal inventories of coal in the hands of consumers or retailers amount to about 7.3 million tons each

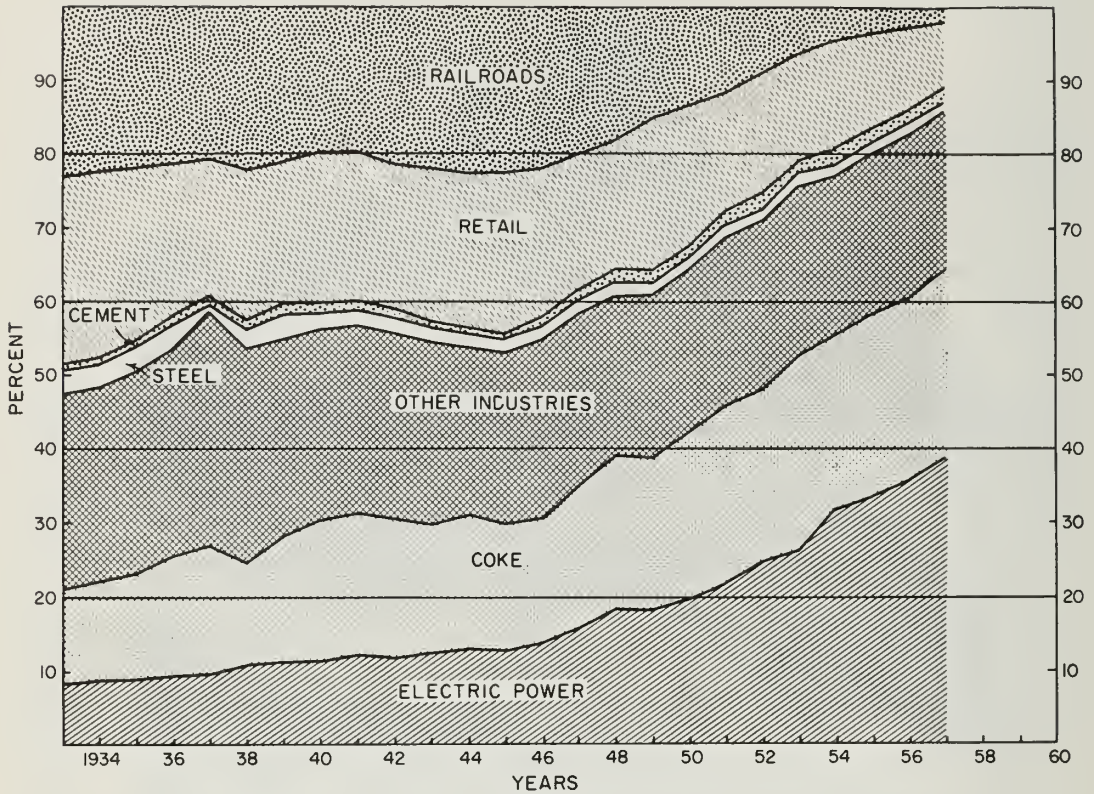


Fig. 2. - Percentage of coal used in the United States, by consumer groups.

year, as shown in figure 3, which shows average monthly industrial inventories, consumption, and production of coal over the 5-year period 1953 through 1957. Production is calculated as the quantity of coal consumed plus or minus the inventory change during a given period. Beginning in about March of each year, a gradual build-up occurs until a peak is reached in about September or October. From November until March there is a gradual decline in coal stocks as the inventories are used.

Consumption, on the other hand, follows a similar seasonal pattern, but with a lag of about four months. The low point of consumption usually occurs in July, the peak consumption in January. As the consumption begins to decline in late winter and early spring, production is supported by the demand for coal to replenish stocks consumed during the winter. On the chart it may be seen that except for July, when the miners take their annual 10-day vacation and production ceases almost entirely, the production is maintained at a fairly stable level. A comparison of the variation in consumption with that in production gives some measure of the beneficial effects of seasonal inventories in stabilizing coal production.

Seasonal inventories de-emphasize the effect of seasonal fluctuations in demand, but protective inventories emphasize or expand the effects of cyclical fluctuations caused by changes in business activity. Figure 4 illustrates the influence of inventories on the level of coal production when cyclical changes in

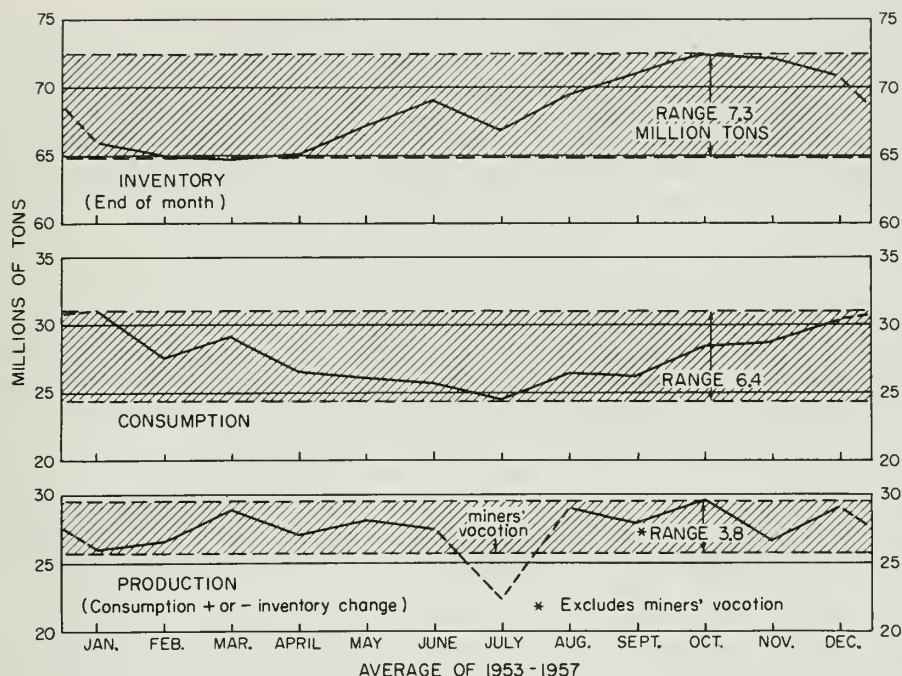


Fig. 3. - Effect of seasonal changes in industrial inventories on United States coal production.

consumption occur. In 1952, consumption of coal in the United States was almost 419 million tons, and there was no appreciable change in inventories. During the next year an 8 million ton increase in consumption, accompanied by a 4 million ton increase in inventories, caused a total production increase of 12 million tons. In other words, a 1.9 percent increase in consumption was accompanied by a 2.9 percent increase in production. The following year, during the recession of 1954, consumption dropped 15 percent, but production fell 18.3 percent. Two years later, in 1956, consumption had risen 69.8 million tons or 19.2 percent above the 1954 low, but production had risen 26 percent.

Annual totals, as presented in figure 4, fail to show the rapid and severe fluctuations that sometimes occur during shorter periods of time due to business fluctuations. Study of monthly or other short-term changes resulting from business fluctuations, however, requires that the data be adjusted to exclude, insofar as possible, those changes in consumption, production, and inventory levels that result from normal seasonal variations. In figure 5, changes in inventories, consumption, and production in electric utilities, coke, and "other industrials" have been adjusted for seasonal variation. The period from 1953 to 1958 was selected because it is the longest recent period in which coal production has not been interrupted by any serious strike. Furthermore, the period includes a complete cycle sequence (recession of 1954, the more prosperous years of 1955 and 1956, and the recession that began about the middle of 1957). Consumption and production are given in millions of tons per month.

Consumption, on a seasonally adjusted basis, declined from a peak of 28.3 million tons in July 1953, to 25.2 million tons in January 1954, and by

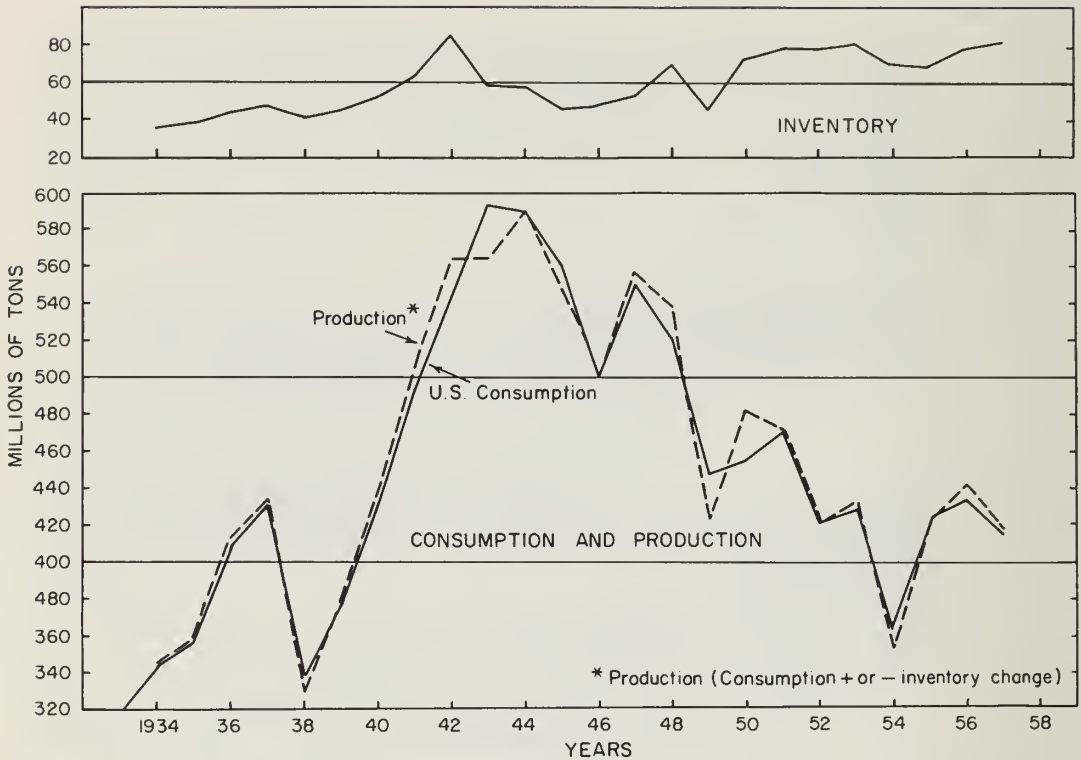


Fig. 4. - Effect of inventory changes on the annual coal production of the United States.

August 1954 had reached a low point of 22.1 million tons per month. The decline was very gradual and steady, with about half the total decline of 6.2 million tons occurring in the first six months. Production, on the other hand, declined slowly during the first six months, and then dropped abruptly. Of the 10.5 million ton decline which occurred over twelve months from July 1953 through June 1954, a drop of only 3.2 million tons occurred during the first six months and the remaining 7.3 million ton decline occurred in the six month period from January through June 1954. The chart shows that the reason for the delayed action was the continued build-up of inventory after consumption began to decline. As soon as the build-up ceased and liquidation of inventories began, the decline in production became rapid and severe. During the total period of decline, consumption fell 22 percent, whereas production fell 32.6 percent. Tonnagewise, the drop in production was 69.3 percent greater than in consumption.

In the revival and growth of the coal industry during the 18 months following the decline, the increase in production was 37 percent greater than that in consumption.

Production and consumption trends during the 1957-1958 recession followed much the same patterns as those in 1953-1954. In this latter recession, however, the declines were not as great as they had been during the earlier period. The declines from mid-1957 to mid-1958 amounted to about 6 million tons in consumption and 7.6 million tons, or 27 percent more, in production. As was true during

the 1954 recession, production maintained a higher level for the first several months while inventories were growing, and then abruptly dropped to a lower level when consumption of inventory stocks began. During the summer of 1958, seasonally adjusted production was running at a rate of about one million tons per month below consumption, with the difference being made up by coal withdrawn from stocks. Seasonally adjusted inventories showed their first gain in September 1958. Increased consumption in September, together with a slight rebuilding of inventories, resulted in a decided upturn. In October, production was $5\frac{1}{2}$ million tons above the summer low, but consumption showed only about half that gain.

The parallel behavior shown by consumption and protective inventories is to be expected. When consumption turns downward, the need for inventory stocks is reduced. The build-up which occurs at such a time results partly from continued delivery of coal already on order and partly from consumers' reluctance to change their inventory practice until the downward trend has been definitely established. When the trend is certain, consumers begin to pull on their inventories and reduce their purchases of coal. By this time they have not only their normal supply to draw on but an additional build-up as well. Even though purchases of coal may be sharply reduced, stocks on hand tend to shrink rather slowly, and an extended period of time is required to bring them in line with the lowered rate of consumption.

On July 31, 1958, protective inventory stocks in the hands of major consumer groups were about $4\frac{1}{2}$ million tons less than on July 31, 1957, and $7\frac{1}{2}$ million tons less than on January 31, 1958. Yet, despite the drastic reduction in tonnage, coal inventories in July 1958 remained higher in terms of consumption than they were a year earlier. This can be seen from table 5.

Table 5.- Days Supply of Coal on Hand at Current Rate of Consumption

| Consumer group | July 31, 1958 | January 1, 1958 | July 1, 1957 |
|--------------------------|---------------|-----------------|--------------|
| Electric power utilities | 124 | 104 | 118 |
| Coke ovens | 55 | 61 | 40 |
| Other industrials | 58 | 45 | 62 |

The manner in which protective inventories tend to accentuate or magnify the effects of fluctuations in coal consumption is shown in figure 5. Although the rebuilding of consumers' inventories may give the coal industry a temporary period of prosperity, the benefits probably are more than offset by the extreme drop in production during periods of inventory reduction. The net result is that the coal industry is subject to much more violent fluctuations than are the consuming industries.

Among the many problems brought by fluctuations in production, perhaps the greatest is that of maintaining suitable productive capacity. Capacity keyed to peak demand means excess investment, maintenance, and other costs when the need for coal slackens. Capacity based on the lowest production rate, or even the average, is grossly inadequate during peak demand. As a result, the coal industry maintains a capacity considerably larger than can effectively be used during normal operations. Estimates by the United States Bureau of Mines indicate

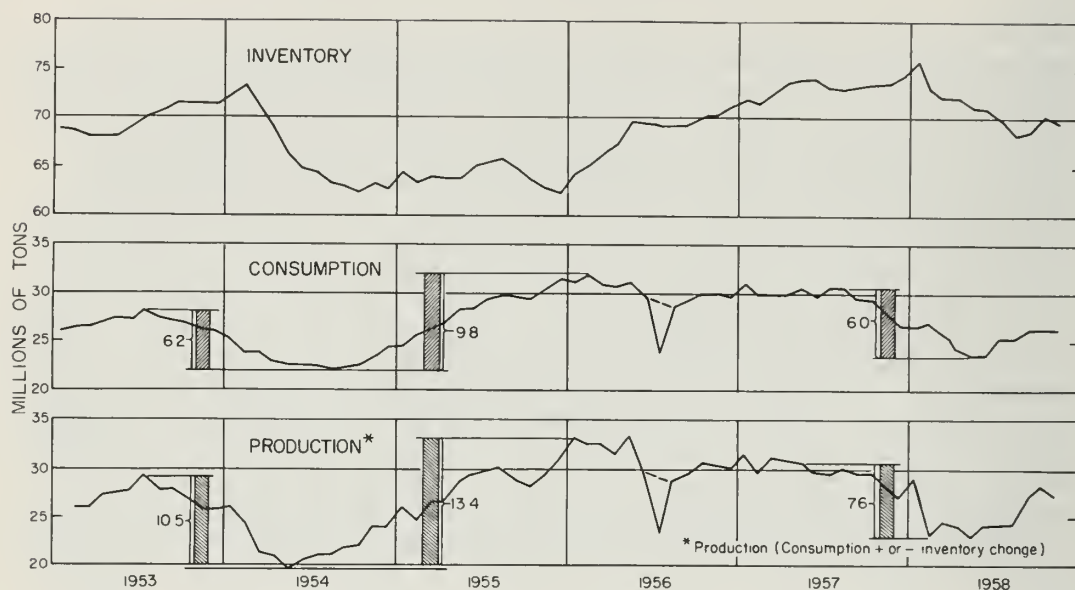


Fig. 5. - Effect of inventory changes on monthly coal production of the United States. Inventories, adjusted for seasonal variation, include those stocked by electric utilities, coke plants, and other industrials.

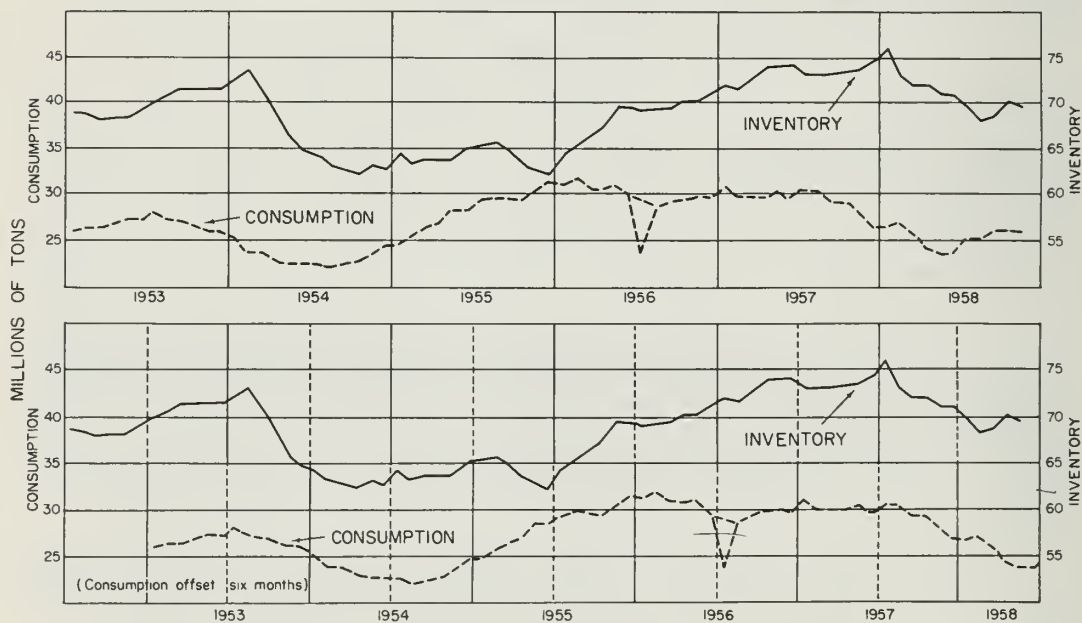


Fig. 6. - Industrial coal consumption and inventories for the United States, adjusted for seasonal variation.

that annual production during the past ten years has ranged from about 56.1 percent to 77.5 percent of productive capacity.

It is unlikely that much can be done to control the fluctuations in coal consumption which accompany changes in industrial activity. It might be, however, that new inventory practices could somewhat reduce the violence of the fluctuations in coal production and thus somewhat alleviate their detrimental effects upon the coal industry. Considerable study and research, both by producers and consumers, appear to be justified. A possible first step in this direction might be further analysis of the behavior of inventories.

The close relationship between coal consumption and inventories is apparent during periods of relative stability. When abrupt changes in the rate of consumption occur, however, the relationship is concealed by the failure of inventories to adjust rapidly upward or downward to meet the new conditions. There appears to be a lag of five or six months, as is illustrated in figure 6. In the upper portion of the figure, consumption and inventory levels are plotted as they normally occur. The curves show some indication of parallel action but its full extent is not apparent. In the lower portion of the figure, consumption and inventory levels are again shown, but the periods of time are offset by six months, and the peaks and troughs of consumption and inventory line up very closely.

The parallel action of consumption and inventories shown in figures 5 and 6 raises some interesting questions. On the basis of their behavior in 1953-54, could the pattern of 1957, both as to changes and as to time at which the changes would occur, be predicted with any degree of accuracy? Equally important, had the pattern been accurately foreseen, would the coal industry have been able to gain from the knowledge?

Perhaps the greatest benefit to be derived is the realization that

- 1) Changes in inventories contribute considerably to the intensity of fluctuations in demand.
- 2) The effects of rapid changes in inventories, both upward and downward, are transitory and do not represent long-term trends.
- 3) Decreases or increases in coal demand resulting from these rapid changes in inventories do not form a sound basis for long-term planning of productive capacity.



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